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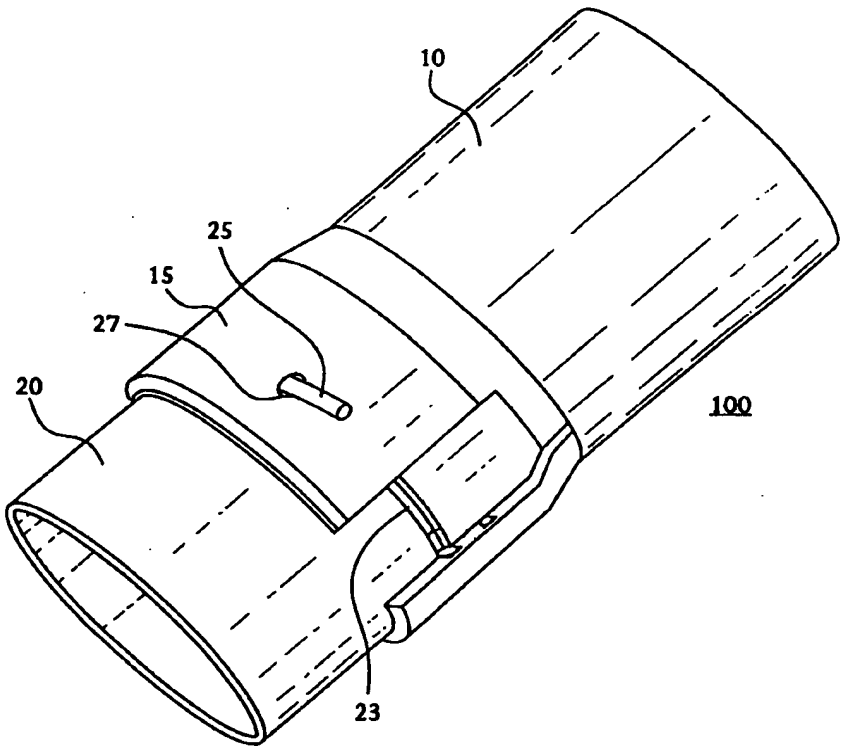
(54) Title: RESTRAINED BELL AND SPIGOT FLUID PIPE CONNECTION

(57) Abstract

Bell and spigot fluid pipe connections (100) are provided in this invention which include a first pipe (10) having a first end which is sized to receive a second end of a second pipe (20) in a male to female relationship. The first and second pipes (10, 20) include annular recesses (22, 23) which form an annular cavity when the second pipe is inserted into the first end of the first pipe. A flexible spline (25) is located within this annular cavity to provide reversible restraint to the bell and spigot connection (100). A fluid-tight gasket (30) is also provided distally from the spline (25). This gasket (30) can be located in an annular recess (24) disposed in the outer surface of the second pipe (20) or along the inner surface of the first pipe (10), or alternatively, at about the distal end of the second pipe to provide a fluid-tight seal.



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RESTRAINED BELL AND SPIGOT FLUID PIPE CONNECTION

Field of the Invention

This invention relates to devices for joining pipes together, and more particularly, to the joining of fluid transport piping including bell and spigot pipe portions.

Background of the Invention

Pipe junction restrainers and techniques for their assembly have been developed to make fluid-tight connections between two axially-aligned pipes, joints, valves, fittings, hydrants, or other types of fluid connections. Often, these junction restrainers must withstand extraordinarily great pressures and tensile loads associated with water distribution and sewer connections.

It has been a current trend to employ polyvinyl chloride (PVC) plastic pipe in new construction. PVC pipes are often connected by a solvent weld or threaded joint. Solvent cement joints, while popular, release volatile gas and vapors which are unhealthy to workers and the environment. Glued joints also required substantial destruction of the coupling and piping in order to disassemble. Threaded joints have been widely used on smaller pipe diameters in bell and spigot and same-diameter coupling designs. While threaded joints are reversible, the task is usually time consuming and increases labor costs, especially if a PTFE tape is used. Pipe-thread type joints are also easily distorted and damaged during pipe installation.

Newer systems have included a spline as a restraining device. One popular system employed for connecting PVC pipe, sold under the trademark CERTA-LOK™ and produced by CertainTeed Corporation, Valley Forge, Pennsylvania, provides a restrained joint between a pair of pipe sections for municipal, fire protection, mining, irrigation, well casings, and other industrial uses. The joint connector uses a pair of o-ring seals and internal annular cavities that are filled externally with polymeric splines after two sections of PVC pipe are inserted into a tubular connector. These splines fill a pair of annular cavities located on the pipe sections to form a restraining mechanical lock that has a rating of about 150 psi and up. Since the restraining mechanism of the CERTA-LOK™ joint connector is uniformly

distributed around the PVC pipes, the risk of damaging the plastic sidewalls by localized stress fracture can be minimized. Similar connector designs are disclosed in French Pat. No. 1,397,378.

In addition to spline restraints in pipe connections using pipes of similar diameters, spline connections have been used in bell and spigot designs with gland connections for attaching pipes to valves and fittings of dissimilar materials, such as the connection disclosed in Himmelberger, U.S. Patent No. 5,509,699. Additionally, straight dowels have been used to connect bell and spigot-type thermoplastic piping systems, which additionally rely on cast resins for fixing the joint to prevent rotation. See W. Schwarz, U.S. Patent No. 3,606,401.

While various connection systems are available for providing fluid-tight seals to pipes manufactured with various materials, there remains a need to greater simplify the process of making reversible fluid connections to minimize labor costs and provide quick disconnect capability.

Summary of the Invention

The present invention provides a bell and spigot-type pipe connection for making a fluid connection between first and second pipes. This connection includes a first pipe having a first end, including a generally bell-shaped inner surface including a first annular recess, and a second pipe having a second end sized to fit within a cavity defined by said generally bell-shaped inner surface of the first pipe. The second pipe includes a second annular recess which can be aligned with the first annular recess of the bell-shaped inner surface to provide an annular cavity. The connection further includes an access hole disposed through a sidewall of the first end of the first pipe and a flexible spline disposed through this access hole and into the annular cavity for providing reversible restraint to the connection. Finally, an elastomeric fluid gasket is disposed between the bell-shaped inner surface and an outer surface of the second pipe, distally along said second pipe from said annular cavity, to provide a fluid-tight seal.

The bell and spigot connections of this invention are light weight and easy to handle, corrosion-resistant and easily reversible. Since no solvent cements are required, these connections are environmentally friendly and the connection joint achieves full strength immediately in all weather conditions. The bell and spigot-type connections of this invention require no separate flanges, sleeves or tubular couplings. This greatly reduces assembly time

since only one spline is needed to install the joint. The overall joining area is generally shorter than in conventional CERTA-LOK™ type joints, and more reliable. It is also easier to pull or push into predrilled holes.

In additional environments of this invention, a method of joining piping is provided in which a bell and spigot-type joint is constructed using a single spline deposed in an annular cavity formed between an inner surface of a bell-portion of a first pipe and an outer surface of a second pipe inserted into the bell-portion.

A Brief Description of the Drawings

The accompanying drawings illustrate preferred embodiments of this invention according to the practical application of the principles thereof, and in which:

FIG. 1: is a front partial, cross-sectional view of a bell and spigot pipe connection of this invention;

FIG. 2: is a front partial, cross-sectional perspective view of the pipe connection of FIG. 1;

FIG. 3: is an enlarged cross-sectonal view of a preferred spline and annular cavity restraining device of the pipe connection of this invention;

FIG. 4: is an enlarged cross-sectional view of a preferred elastomeric fluid gasket disposed in an annular groove along the bell-shaped inner surface of the first pipe;

FIG. 5: is a front, partial cross-sectional perspective view of another pipe connection of this invention;

FIG. 6: is an enlarged cross-sectional view of a preferred spline and annular cavity restraining device of the alternative pipe connection of FIG. 5; and

FIG. 7: is an enlarged cross-sectional view of a preferred elastomeric fluid gasket disposed in an annular grove along the bell-shaped inner surface of the alternative pipe connection of FIG. 5.

A Detailed Description of the Invention

This invention provides mechanical joints, such as those used between piping materials, including pipes, valves, various pipe fittings, hydrants, and miscellaneous connections and piping systems, including sewer systems, water distribution systems, electrical conduits for telecommunication and electrical cables, and the like, horizontal line service, such as, mining and chemical transport piping, and vertical line service, such as, well

pipes and well casings. As used herein, the term "pipe" includes all of the above connections and those that are consistent with the principles of this invention.

With reference to the figures, and particularly to FIGS. 1 through 4 thereof, a first preferred bell and spigot-type pipe connection 100 will now be described. This pipe connection 100 includes a first pipe 10, preferably made of thermosetting or thermoplastic resin, with or without fillers, additives and reinforcing agents, such as glass fibers. Preferably the first pipe is made from extruded, polyvinyl-chloride, polyethelyne or ABS, polypropylene, fluropolymer plastics. The first pipe includes a first end having a generally bell-shaped portion 15 including a generally bell-shaped surface therein. The bell-shaped inner surface includes a first annular recess 22. As defined herein, the terms "bell" and "bell-shaped" refer to a configuration having a tapered circular wall portion, commonly referred to as the "transition," therein. Any reference to a classic bell shape is for convenience only, since the term "bell" is already recognized in the pipe industry as having numerous shapes and sizes, yet capable of providing a male-female coupling between fluid pipes without substantially detracting, or negatively affecting the flow of fluid therethrough. It is understood that the bell-portion 15 can be of any length, although a short length of less than about 12 inches, preferably about 2.75 inches, provides adequate strength without prohibitively increasing the cost.

The pipe connection 100 further includes a second pipe 20, preferably made from the same materials as the first pipe 10, having a second end sized to fit within a cavity defined by said generally bell-shaped inner surface of said first pipe 10. The second pipe 20 includes a second annular recess 23 on its outer diameter which can be matched or aligned with a first annular recess 22 located on the bell-shaped inner surface to provide an annular cavity. As disclosed in FIG. 2, an access hole 27 is provided through a side wall in the bell-portion 15 so as to communicate with the annular cavity formed by annular recesses 22 and 23 as better described in the enlarged view of FIG. 3. A flexible spline 25 is inserted through the access hole 27 and into locking engagement within the annular cavity. The flexible spline 25 is desirably made from a polymeric material having a shear strength or a tensile strength that is within 10% of the shear strength or tensile strength of the pipe resin compound used in the pipes 10 and 20, and more preferably, the spline 25 has a greater shear or tensile strength. Good examples of resins for this application include nylon, polyester, polyurethane, polysulfone, or polyether-ether-ketone (PEEK). These differences in mechanical properties

are important so as to minimize unintended failure of the pipe connection 100 due to deformation of the spline 25. The spline 25 must also have equal or greater chemical resistance than that of the pipes 10 and 20.

The pipe connection 100 also contains at least a third annular recess located either on the bell-shaped inner surface of the first pipe 10 or on the exterior surface of the second pipe 20, in a position which is distally located from the first or second annular recess 22 or 23, following assembly of the pipe connection 100. These two options for the placement of the third annular recess are depicted by pipe connections 100 and 200 described in FIGS. 2 and 5 respectively, and, more specifically, in FIGS. 4 and 7. As shown in the enlarged view of FIG. 4, an elastomeric gasket 30, such as a rubber or synthetic rubber o-ring, is disposed within annular recess 24 along the bell-shaped inner surface of bell-portion 15. As pipe 20 is inserted within this bell-shaped cavity, its outer wall compresses against the o-ring 30 to form a fluid-tight seal. The annular recess 24 can form a cross-sectional cavity which is shaped so that the base of the cavity is wider than the cavity mouth as shown in FIG. 7. This permits the compressed and deformed gasket 30 to lock itself in position during insertion of pipe 20. Optionally, the annular recesses 24 and 224 can be shaped as rectangular or square cross-sections.

The bell and spigot-type pipe connection 200 shown in FIG. 5 uses many of the same features as the pipe connection 100. Namely, a first pipe 210 is provided with a bell-portion 215 for receiving a second pipe 220 in a male-female nested arrangement. The bell-portion 215 includes an access hole 227 for receiving a flexible spline 225 which enters into an annular cavity formed by a pair of annular recesses 222 and 223 formed in the first and second pipes 210 and 220 respectively. This feature is shown in FIG. 6. Unlike the arrangement of pipe connection 100, however, pipe connection 200 reverses the location of the third annular recess 224 for retaining its gasket 230. Annular recess 224 is, instead, cut into the outer surface of the second pipe 220, distally from the annular recess 223 so as to provide a fluid-tight seal when the second pipe 220 is inserted into the bell-shaped cavity of the first pipe 210.

Alternatively, a gasket member (not shown) can be inserted into the bell-shaped cavity of the first pipe 10 or 210 of the pipe connections 100 and 200 of this invention, so as to receive the first end of the second pipes 10 and 210 and form a fluid seal between the conical section of the bell-shaped cavity of the first pipe 10 or 210 and the distal end of the

second pipes 20 and 220. This invention also contemplates that the annular cavities formed by first and second annular groves 22 and 23 or 222 and 223, can be filled with a curable material such as an air curable or hot melt thermoplastic resin, or the like, to form a solid material in the annular cavities for restraining the joint. Of course, this is a more permanent piping solution.

From the foregoing, it can be realized that this invention provides improved bell and spigot-type fluid connections for reducing the cost of piping systems. A reduction in cost is created by the elimination of a separate flange or connecting tubular member, or the requirement of additional splines or gaskets to provide a restrained fluid-tight seal. The bell and spigot-type fluid-tight connections of this invention are ideal for well casings, which generally include a pump, coaxial water distribution line and/or electric motor for powering the pump. Although various embodiments have been illustrated, this was for the purpose of describing, and not limiting, the invention. Various modifications, which will become apparent to one skilled in the art are within the scope of this invention described in the attached claims.

What is claimed is:

1. A bell and spigot-type pipe connection for making a generally fluid-tight connection between first and second pipes having first and second ends respectively; said connection comprising:

a first pipe having a first end having a generally bell-shaped inner surface, said generally bell-shaped inner surface including a first annular recess;

a second pipe having a second end sized to fit within a cavity defined by said generally bell shaped inner surface, said second pipe having a second annular recess which can be aligned with said first annular recess to provide an annular cavity;

an access opening disposed through a sidewall of said first end of said first pipe;

a flexible spline disposed through said access opening and into said annular cavity, for providing reversible restraint, and

an elastomeric fluid gasket disposed between said bell-shaped inner surface of said first pipe and an outer surface of said second pipe, said gasket located distally along said second pipe from said annular cavity.

2. A mechanical pipe connection of claim 1 wherein said elastomeric fluid gasket is disposed in a third annular recess.

3. A mechanical pipe connection of claim 2 wherein cavity in said third annular recess is located along said bell-shaped inner surface.

4. A mechanical pipe connection of claim 2 wherein said third annular recess is located along an outer surface of said second pipe.

5. The mechanical pipe connection of claim 1 wherein said first and second pipes comprise a first polymeric material.

6. A mechanical pipe connection of claim 5 wherein said spline comprises a second polymeric material having a shear strength which is about equal to or greater than said first polymeric material.

7. The mechanical pipe connection of claim 6 wherein said first polymeric material comprises polyvinyl-chloride and said second polymeric material comprises a nylon, polyester, PEEK, or polyurethane resin.

8. The mechanical pipe connection of claim 1 wherein said first and second pipes comprise a flowing fluid.

9. The mechanical pipe connection of claim 1 wherein said spline comprises a round, square, oval, rectangular, or trapezoidal cross-section.

10. A method of making a bell and spigot-type fluid connection between first and second pipes, said method comprising:

(a) providing a first pipe having an access opening through a side wall thereof, and a first end containing a generally bell-shaped inner surface therein, said bell-shaped inner surface including a first annular recess;

(b) providing a second pipe having a second end sized to fit within a cavity defined by said generally bell-shaped inner surface of said first pipe, said second pipe having a second annular recess;

(c) inserting said second pipe into said cavity defined by said generally bell-shaped inner surface of said first pipe so as to align first annular recess with said second annular recess to define an annular cavity;

(d) inserting a flexible spline through said access opening of said first pipe into said annular cavity to provide a reversible restraint; and

(e) compressing an elastomeric fluid gasket between said bell-shaped inner surface of said first pipe and an outer surface of said second pipe to provide a fluid-tight seal.

11. The method of claim 10 wherein said elastomeric fluid gasket is disposed within a third annular recess located along said bell-shaped inner surface of said first pipe.

12. The method of claim 10 where said elastomeric fluid gasket is located within a third annular recess located distally from said second annular recess along an outer surface of said second pipe.

13. The method of claim 10 further comprising pumping a fluid through said pipe connection.

14. A bell and spigot-type pipe connection for making a substantially fluid-tight connection between first and second pipes having first and second ends respectively; said connection comprising:

(a) a first pipe having a first end having a conically shaped wall portion therein and a first annular recess;

(b) a second pipe having a second end sized to fit within said first end of said first pipe; said second pipe having a second annular recess which can be aligned with said first annular recess to provide an annular cavity;

(c) an access opening disposed through a sidewall of said first end of said first pipe;

(d) a flexible spline disposed through said access opening and into said annular cavity for providing reversible restraint to said connection; and

(e) an elastomeric fluid gasket disposed between said first pipe and said second pipe to provide a fluid-tight seal.

15. The pipe connection of claim 14 wherein said elastomeric fluid gasket comprises a rubber or synthetic rubber O-ring, or profile gasket.

16. The pipe connection of claim 15 wherein said O-ring is disposed within a third annular recess located on an inner surface of said first end of said first pipe.

17. The pipe connection of claim 16 wherein said third annular recess comprises a cavity cross section having a bottom surface which is larger than its opening so as to contain said O-ring when said O-ring is compressed within said third annular recess.

18. The pipe connection of claim 14 wherein said second end of said second pipe is tapered.

19. The pipe connection of claim 18 wherein said conically shaped wall portion of said first end of said first pipe is sized to receive said tapered portion of said second end of said second pipe.

20. The pipe connection of claim 14 further comprising a moving fluid under pressure.

21. The pipe connection of claim 14 wherein said first and second pipes represent a portion of a well casing.

22. The pipe connection of claim 21 wherein said first and second pipes comprise a water pump and coaxial water distribution line disposed therein.

AMENDED CLAIMS

[received by the International Bureau on 14 July 1999 (14.07.99);
original claims 1, 8, 10, 14, 17, 19 and 21 amended;
original claims 2-4, 11, 12, 16 and 22 cancelled;
remaining claims unchanged (3 pages)]

1. A bell and spigot-type pipe connection for making a generally fluid-tight connection between first and second pipes having first and second ends respectively; said connection comprising:

a first pipe having a bell-shaped first end having a generally bell-shaped inner surface, said generally bell-shaped inner surface including a first annular recess, said bell-shaped first end having a single-wall with a substantially constant wall thickness that is about equal to a wall thickness of a second end of the first pipe remote from the first end;

a second pipe having a tapered second end sized to fit within a cavity defined by said generally bell shaped inner surface, said second pipe having a second annular recess which can be aligned with said first annular recess to provide an annular cavity;

an access opening disposed through a sidewall of said first end of said first pipe;

a flexible spline disposed through said access opening and into said annular cavity, for providing reversible restraint, and

an elastomeric fluid gasket disposed between said bell-shaped inner surface of said first pipe and an outer surface of said second pipe, said gasket located distally from said annular cavity in a third annular recess located along said bell-shaped inner surface of said first pipe, said third annular recess having an opening and a bottom surface that is larger than the opening, said elastomeric fluid gasket being oversized so as to project outward from said opening of said third annular recess.

2. (Canceled)

3. (Canceled)

4. (Canceled)

5. The mechanical pipe connection of claim 1 wherein said first and second pipes comprise a first polymeric material.

6. A mechanical pipe connection of claim 5 wherein said spline comprises a second polymeric material having a shear strength which is about equal to or greater than said first polymeric material.

7. The mechanical pipe connection of claim 6 wherein said first polymeric material comprises polyvinyl-chloride and said second polymeric material comprises a nylon, polyester, PEEK, or polyurethane resin.

8. The mechanical pipe connection of claim 1 wherein said first and second pipes have a fluid flowing therethrough.

9. The mechanical pipe connection of claim 1 wherein said spline comprises a round, square, oval, rectangular, or trapezoidal cross-section.

10. A method of making a bell and spigot-type fluid connection between first and second pipes, said method comprising:

(a) providing a first pipe having an access opening through a side wall thereof, and a bell-shaped first end containing a generally bell-shaped inner surface therein, said bell-shaped inner surface including a first annular recess, said bell-shaped first end having a single-wall with a substantially constant wall thickness that is about equal to a wall thickness of a second end of the first pipe remote from the first end;

(b) providing a second pipe having a tapered second end sized to fit within a cavity defined by said generally bell-shaped inner surface of said first pipe, said second pipe having a second annular recess;

(c) inserting said second pipe into said cavity defined by said generally bell-shaped inner surface of said first pipe so as to align first annular recess with said second annular recess to define an annular cavity;

(d) inserting a flexible spline through said access opening of said first pipe into said annular cavity to provide a reversible restraint; and

(e) compressing an elastomeric fluid gasket between said bell-shaped inner surface of said first pipe and an outer surface of said second pipe to provide a fluid-tight seal, said elastomeric fluid gasket being disposed in a third annular recess located along said bell-shaped inner surface of said first pipe, said third annular recess having an opening and a bottom surface that is larger than the opening, said elastomeric fluid gasket being oversized so as to project outward from said opening of said third annular recess.

11. (Canceled)

12. (Canceled)

13. The method of claim 10 further comprising pumping a fluid through said pipe connection.

14. A bell and spigot-type pipe connection for making a substantially fluid-tight connection between first and second pipes having first and second ends respectively; said connection comprising:

(a) a first pipe having a first end having a tapered wall portion therein and a first annular recess, said bell-shaped first end having a single-wall with a substantially constant wall thickness that is about equal to a wall thickness of a second end of the first pipe remote from the first end;

(b) a second pipe having a tapered second end sized to fit within said first end of said first pipe, said second pipe having a second annular recess which can be aligned with said first annular recess to provide an annular cavity;

(c) an access opening disposed through a sidewall of said first end of said first pipe;

(d) a flexible spline disposed through said access opening and into said annular cavity for providing reversible restraint to said connection; and

(e) an elastomeric fluid gasket disposed between said first pipe and said second pipe to provide a fluid-tight seal, said elastomeric fluid gasket being disposed in a third annular recess located along said bell-shaped inner surface of said first pipe, said third annular recess having an opening and a bottom surface that is larger than the opening, said elastomeric fluid gasket being oversized so as to project outward from said opening of said third annular recess.

15. The pipe connection of claim 14 wherein said elastomeric fluid gasket comprises a rubber or synthetic rubber O-ring, or profile gasket.

16. (Canceled)

17. The pipe connection of claim 16 wherein said O-ring is compressed within said third annular recess.

18. The pipe connection of claim 14 wherein said second end of said second pipe is tapered.

19. The pipe connection of claim 18 wherein said tapered wall portion of said first end of said first pipe is sized to receive said tapered portion of said second end of said second pipe.

20. The pipe connection of claim 14 further comprising a moving fluid under pressure.

21. The pipe connection of claim 14 wherein said first and second pipes [represent] form a portion of a well casing.

22. (Canceled)

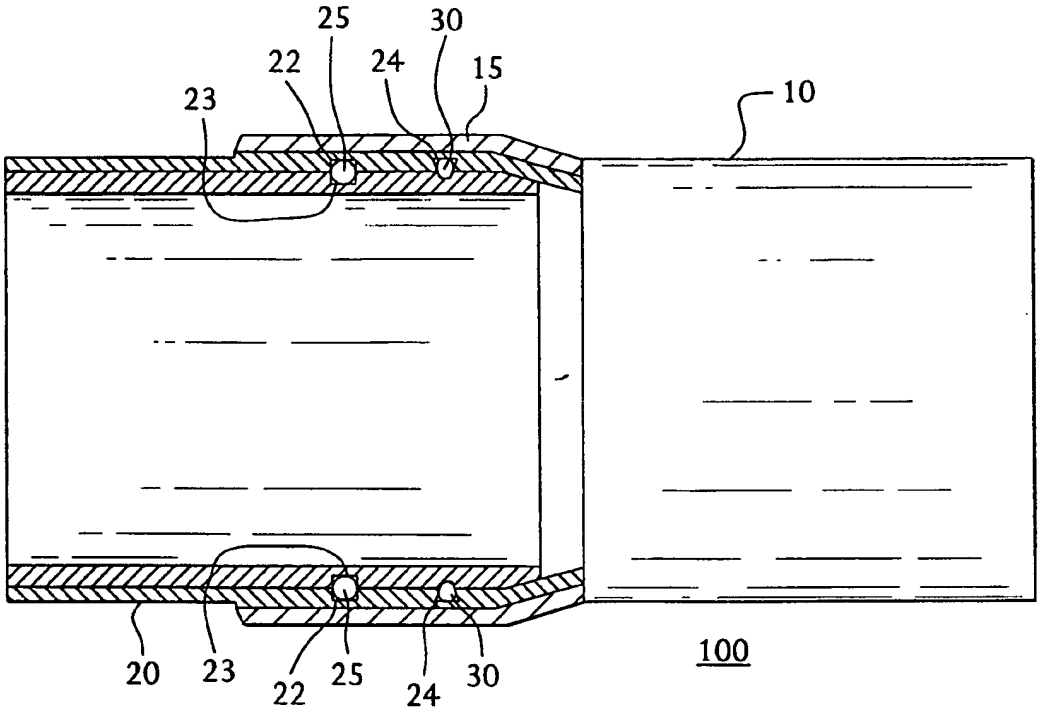

FIG. 1

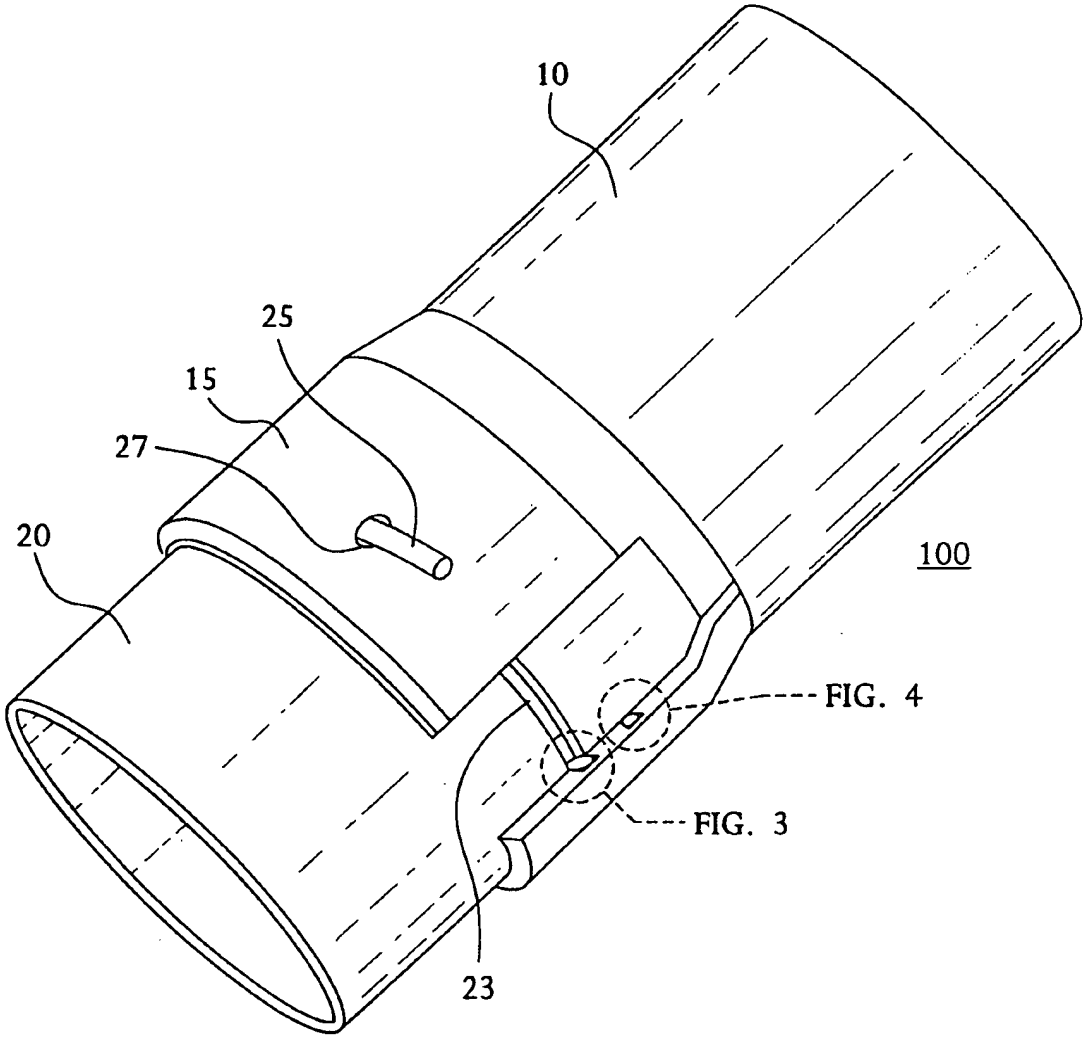

FIG. 2

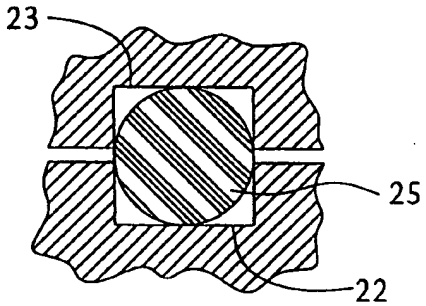

FIG. 3

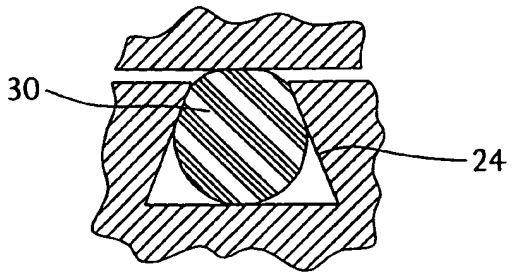

FIG. 4

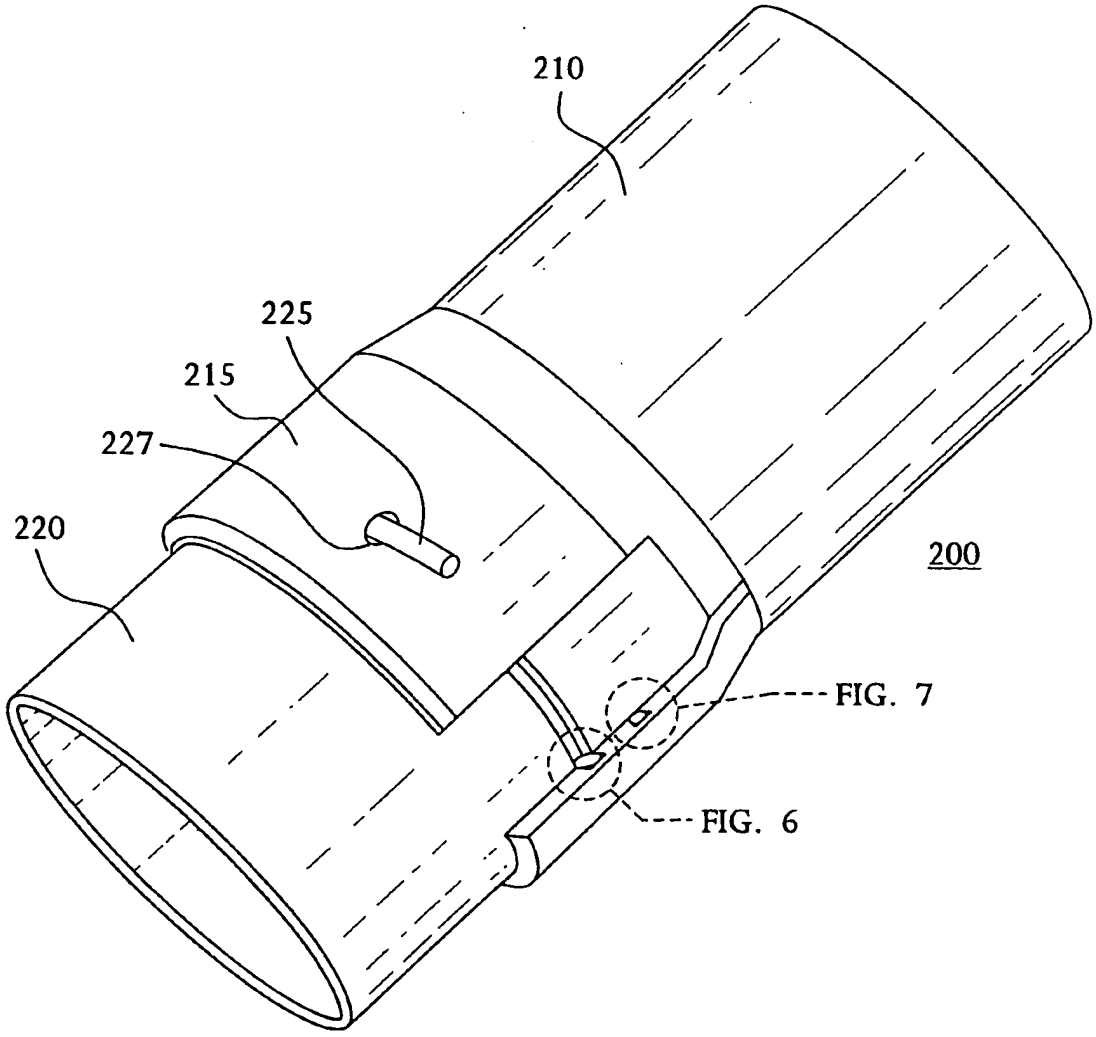

FIG. 5

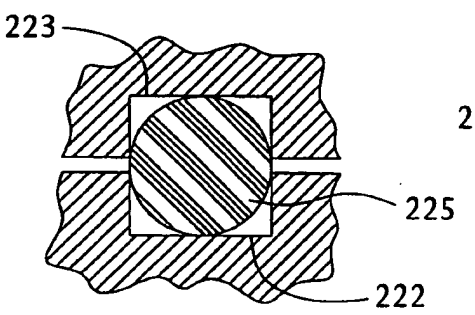

FIG. 6

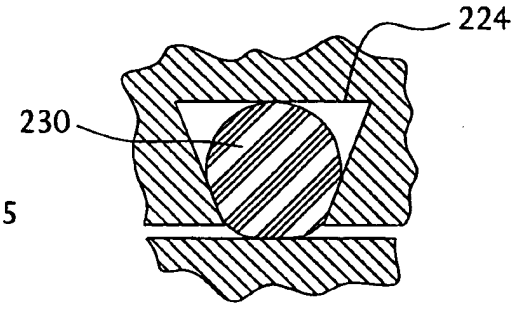

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02475

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :F16L 37/14
US CL :285/305,423

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 285/305,423

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 5,255,945 A (TOON) 26 October 1993 (26-10-93), see splines 8,49 and seal 34.	1,2,3,4,5,8,9,10, 11,12,13
X --- Y	US, 3,759,553 A (CARTER) 18 September 1973 (18-09-73), see spline 10 and seal 7 in groove 6.	1,2,4-10, 12-16, 18-22 -------- 17
X	FR 1,310,712 A (RUSSIER) 22 October 1962 (22-10-62), see spline 3 and seal 6.	1,2,4,8,9, 10,12-16,18,20,21, 22
Y	GB 753,641 A (SARGINSON) 25 July 1956 (25-07-56), see seal 16 in dovetail groove 15.	17

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 28 APRIL 1999	Date of mailing of the international search report 14 MAY 1999
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